

PSC STRAY VOLTAGE DATA UPDATE: THE LATEST STATISTICS FROM THE PSCW DATABASE

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RICHARD S. REINES
PUBLIC SERVICE COMMISSION OF WISCONSIN

The following charts and statistics have been derived from the PSCW's utility stray voltage database which currently has just over 5,000 entries. The data is submitted by the five largest investor-owned utilities in Wisconsin from their first time investigations and contains data from both the farm and the utility system. The data contains only AC, rms steady-state voltage and current parameters.

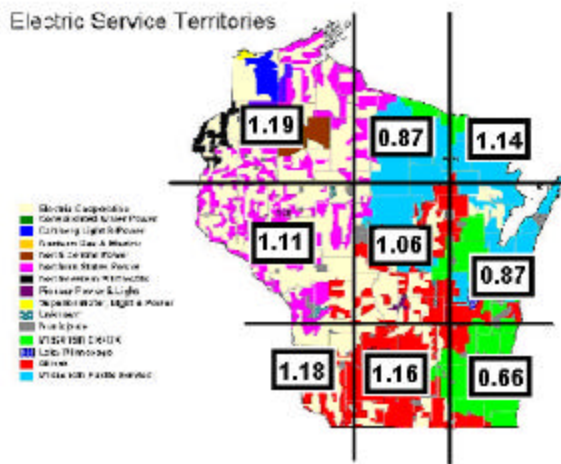


FIGURE 1
Average neutral to earth voltage by geographic area in Volts – 1988-2000
(Includes both primary profile and farm primary neutral to reference data)

| PARAMETER | AVG. VALUE | UNITS |
|---------------------|-----------------|-----------|
| Dist. to Substation | 5.8 | Miles |
| Grounds per Mile | 12 | |
| Source Resistance | 206 (97% < 500) | Ohms |
| Herd Size | 71 | Cows |
| On DHIA program | 59% | |
| RHA Milk Production | 18,460 | Lbs |
| SCC | 377 | (x 1,000) |

Average farm values

Customer type vs. average cow contact current

| | |
|------------------------|------------------|
| END-OF-LINE | Icc AVG = 1.1 mA |
| NON END-OF-LINE | Icc AVG = 1.0 mA |

No significant difference between end-of-line and non end-of-line farms.

| Farm | Icc Avg | RHA Avg | SCC Avg (x1,000) |
|-----------------|----------------|----------------|-------------------------|
| Non-DHIA | 0.96 mA | 16887 | 430 |
| DHIA | 0.79 mA | 19277 | 344 |

Difference between DHIA and non DHIA farms

Commentary of attached charts

Figure 2: The average cow contact current is much lower for farms served by higher primary voltages.

Figure 3: There is an increase in average cow contact current for farms served by systems with small neutral conductors than for those served by systems with medium or large neutral conductors.

Figure 4: Large farms having large primary transformers have less cow contact current than farms with small transformers.

Figure 5: Direct relationship of cow contact current with primary neutral to reference voltage measured at the transformer neutral grounding circuit.

Figure 6: Direct relationship of cow contact current with secondary neutral to reference voltage measured at the main service entrance panel neutral grounding circuit.

Figure 7: Most primary and secondary neutral to reference voltages measured are in the range of 0.71 to 1.5 V AC rms steady state. Only 31% of primary and 27 % of secondary voltages measured are above that range.

Figure 8: Averaging over the last 13 years, only 8.9% of farms have had cow contact currents above the present “level of concern” of 2 milliamps. Only about 30% of farms have had average currents above the 1-millamp level.

Figure 9: The average number of grounds per mile on the primary distribution system is increasing as the number of miles of rural rebuild increases.

Figure 10: As rural rebuilds are finished, the average primary distribution voltage level is increasing. Many 2,400- and 4,800- volt systems are converting to 14,400-volt systems.

Figure 11: As rural rebuilds are finished, the average primary neutral conductor size is increasing. Many #4, #6 and #8 conductors are being replaced with 1/0, 2/0 and 4/0 conductors.

Figure 12: Farm load size is increasing; therefore larger primary transformers are being installed to serve those loads.

Figure 13: Over the last 13 years, measured average cow contact currents have been decreasing on farms. It has been at or below 1 milliamp for 7 of the last 8 years.

Figure 14: The average level of primary neutral to earth voltage at the farm has decreased over the last 13 years. The level is at or below 1.25 volts since 1994.

Figure 15: The average level of secondary neutral to reference voltage measured on farm has slightly increased in the last 9 years.

Figure 16: The average milk production of the farms investigated over the last 9 years has increased.

Figure 17: The average somatic cell count has leveled to between 350,000 and 400,000 for 6 of the last 8 years.

Figure 18: There is no clear association of level of cow contact current and RHA milk production.

Figure 19: There is no clear association of cow contact current and somatic cell count.

Figure 20: About 90% of farms investigated are within 10 miles of the substation.

Figure 21: About 82% of farms investigated have systems with 6 to 15 grounds per mile.

Figure 22: The great majority of farms investigated are served by 7,200-volt primary distribution systems.

Figure 23: About 82% of farms investigated have primary transformers rated 25 to 50 kVA.

Figure 24: About 50 % of farms investigated have primary neutral to reference voltages at or below 1.0 volt.

Figure 25: About 52 % of farms investigated have secondary neutral to reference voltages at or below 1.0 volt.

Figure 26: About 91% of cow contact voltages measured on farms investigated by investor owned utilities are at or below 1.0 volt.

Figure 27: Primary profile data indicates about 90% of rural distribution pole ground rods carry 75 milliamps of current or less.

Figure 28: Farm size by herd numbers indicate 10% are small farms (1 to 30 cows), 84% are average size farms (31 – 150 cows) and 6% are large farms (more than 150 cows).

Figure 29: About 84% of farms investigated have RHA production between 15,00 and 25,000 pounds.

Figure 30: About 83% of farms investigated have somatic cell counts at 500,000 or less.

Figure 31: Primary profile data indicates about 84% of rural distribution pole ground rods have neutral to earth voltages of 1.5 or less.

Figure 32: Primary profile data indicates about 77% of rural distribution pole ground rods measure 70 ohms resistance to earth or less.

Figure 33: The trend of neutral to earth voltage on rural primary distribution ground rods is decreasing and has been below 1.0 volt since 1994.

Figure 34 The trend in isolation of farms has been at 10% or below for the last 8 years.

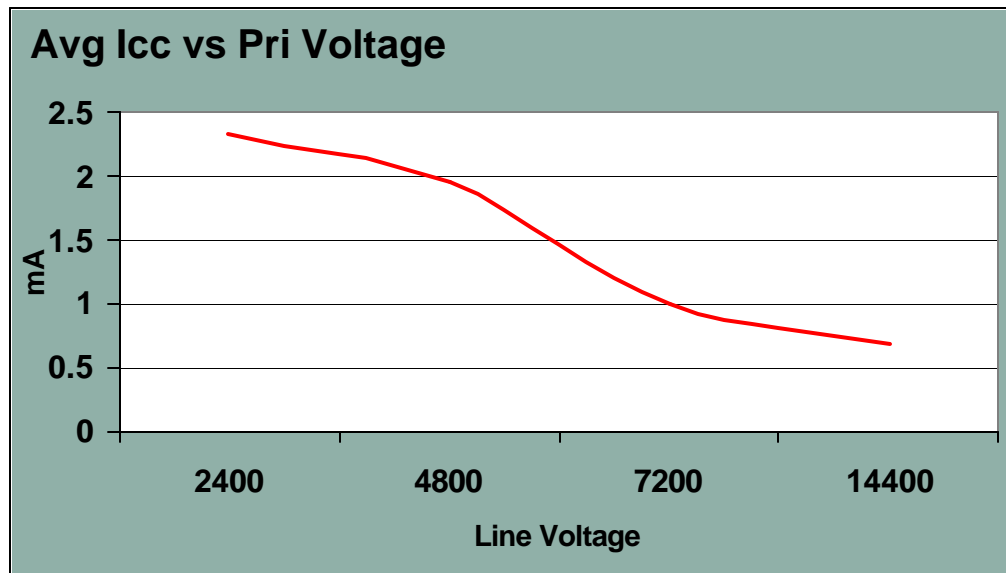


FIGURE 2

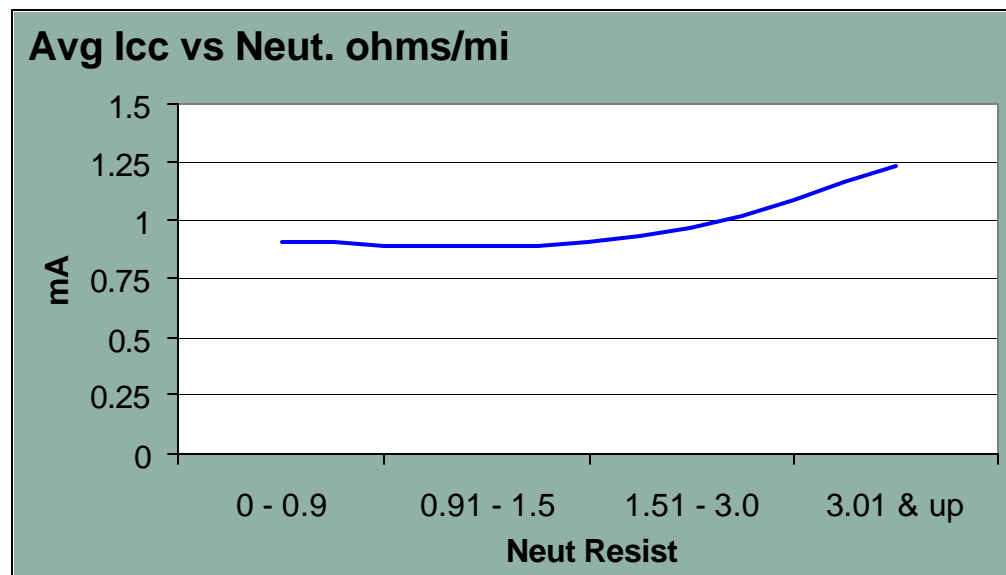


FIGURE 3

Avg Icc vs Transformer kVA

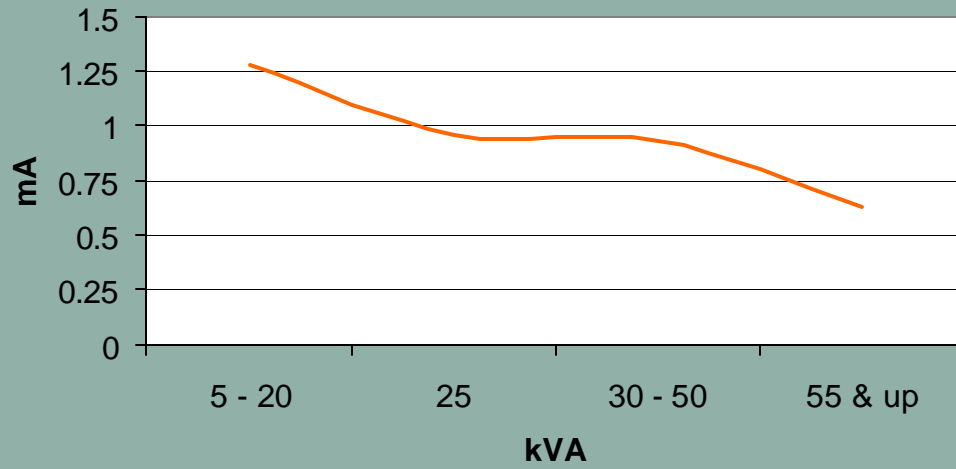


FIGURE 4

Avg Icc vs Vpnref

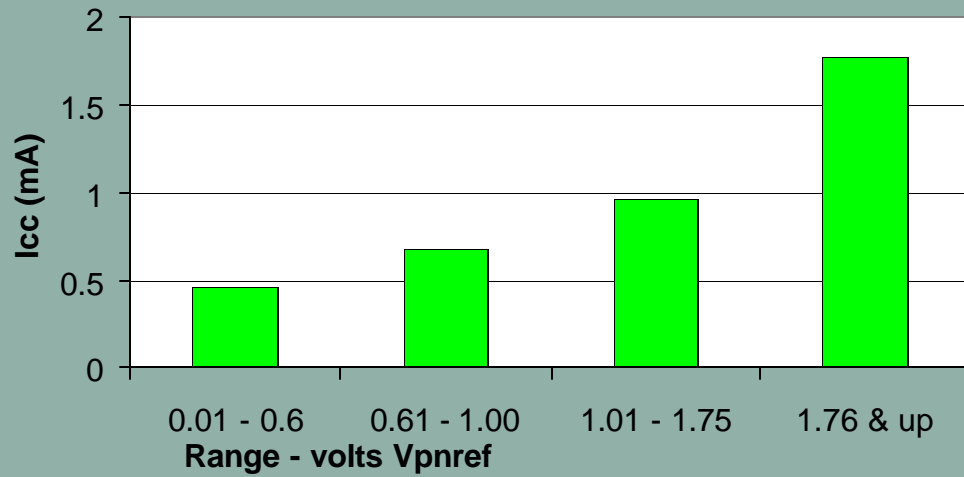


FIGURE 5

Avg Icc vs Vsnref

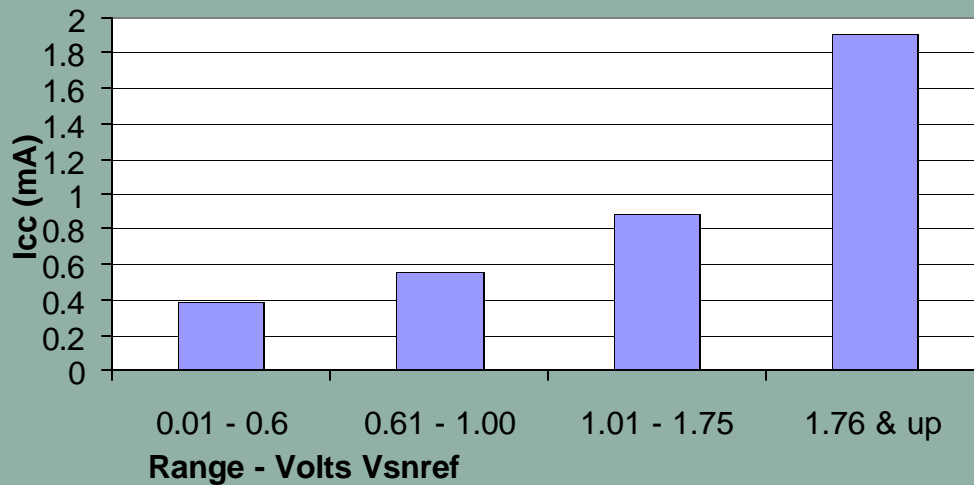


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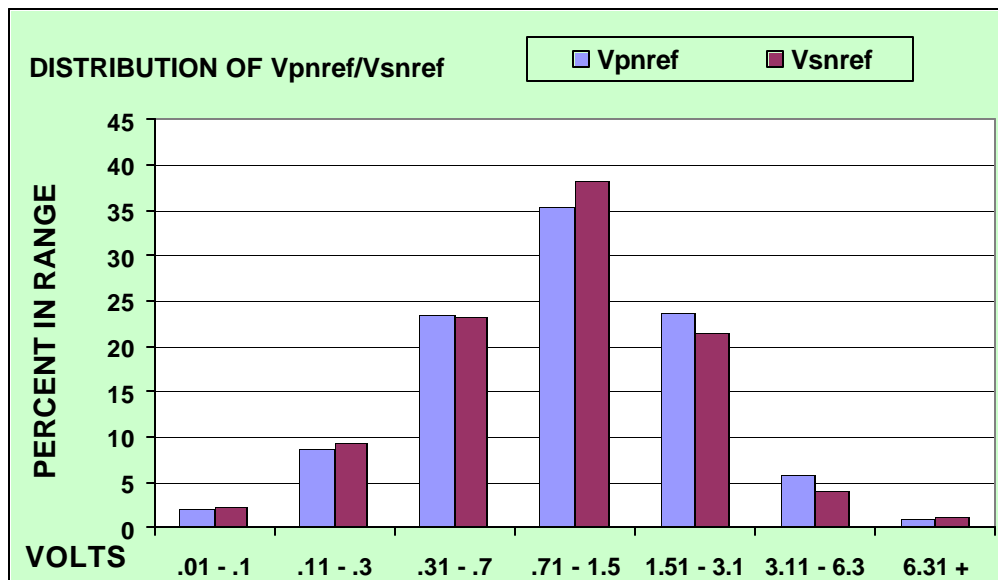


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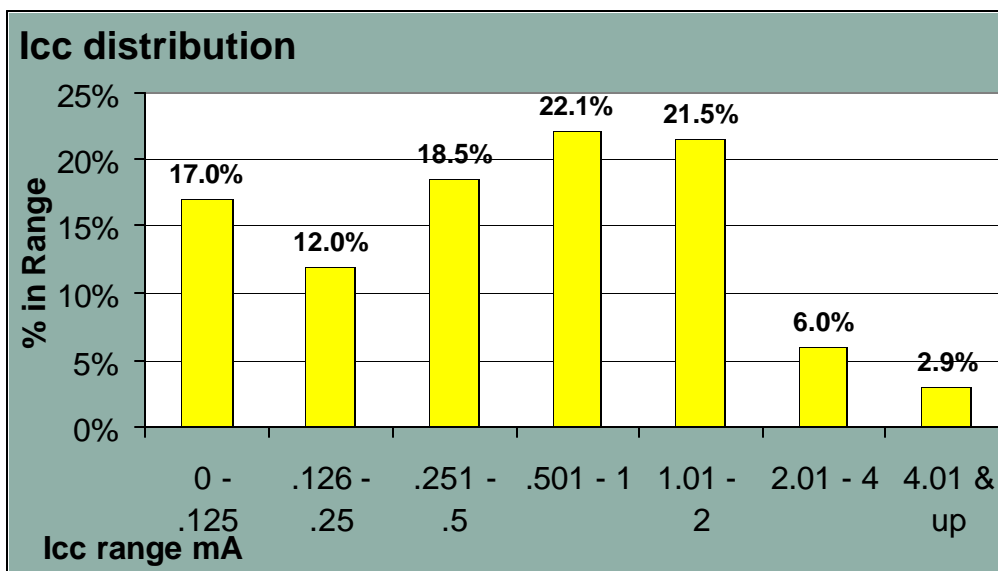


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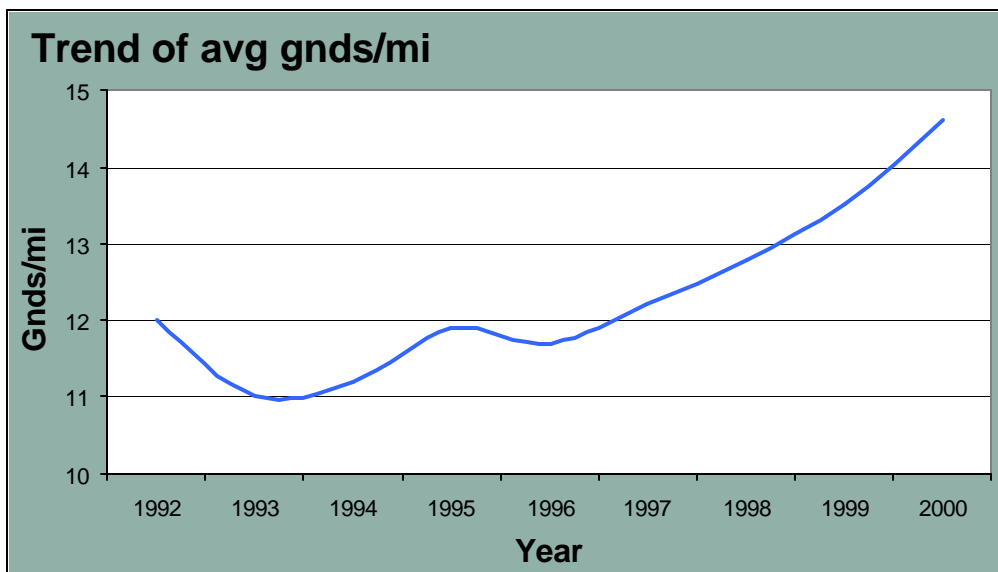


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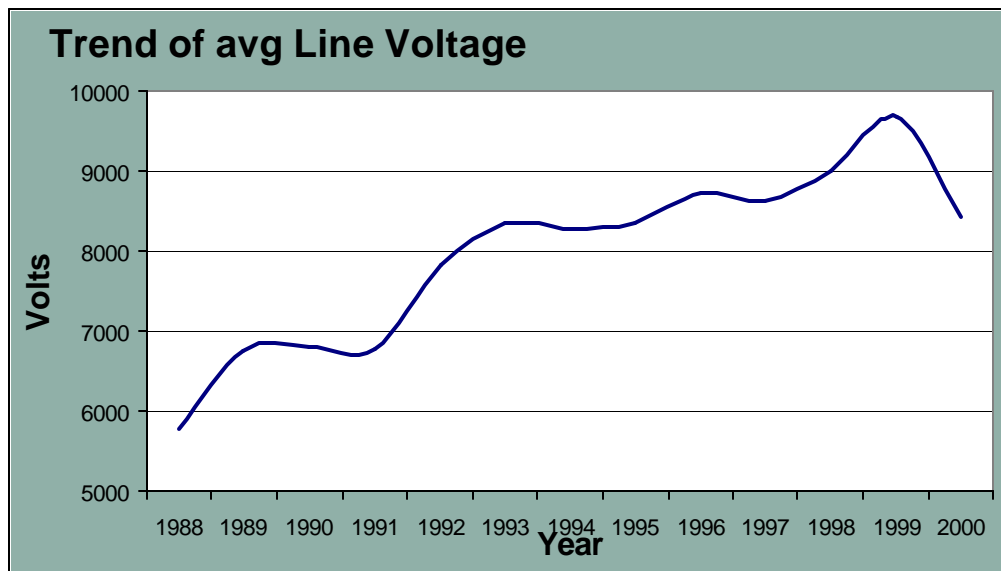


FIGURE 10

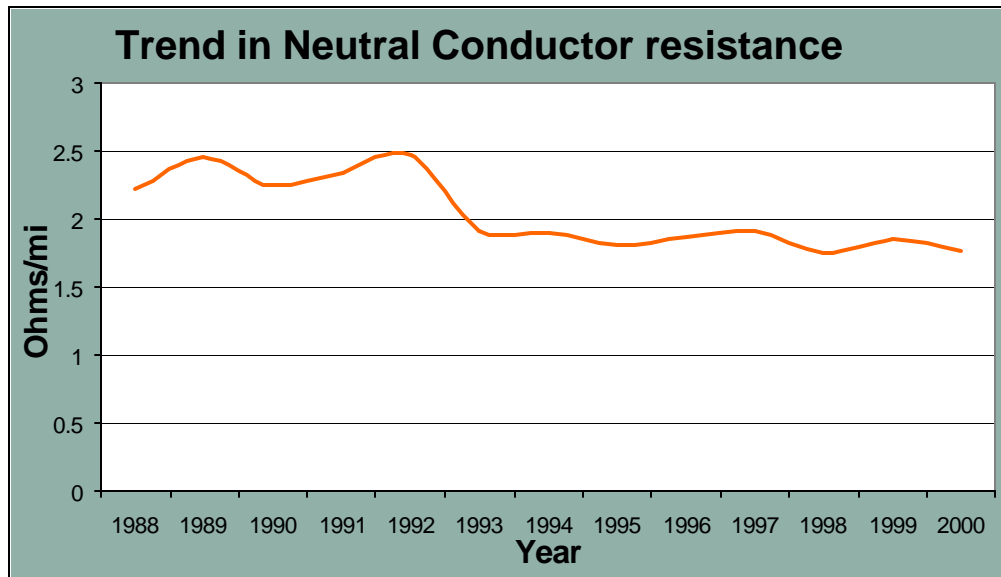


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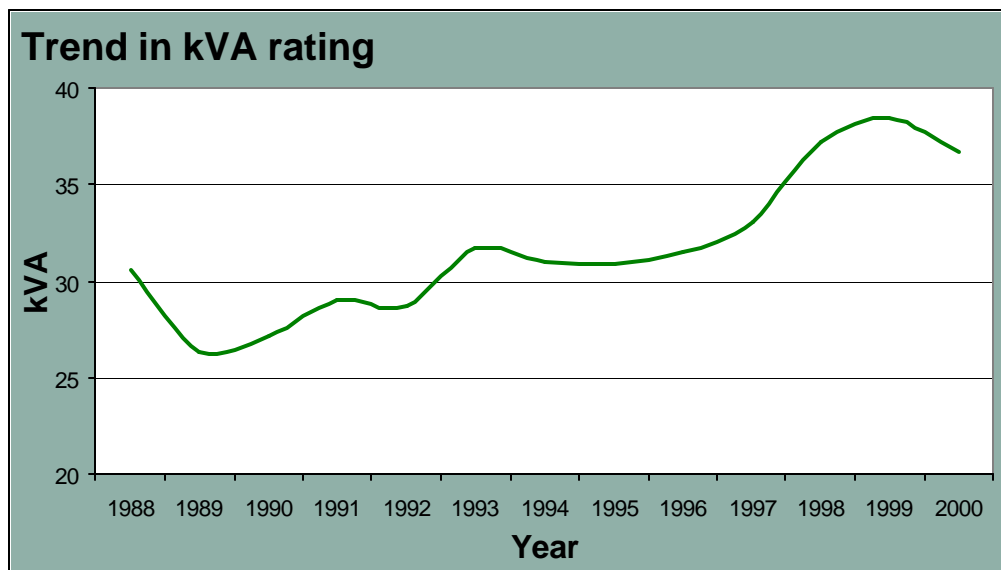


FIGURE 12

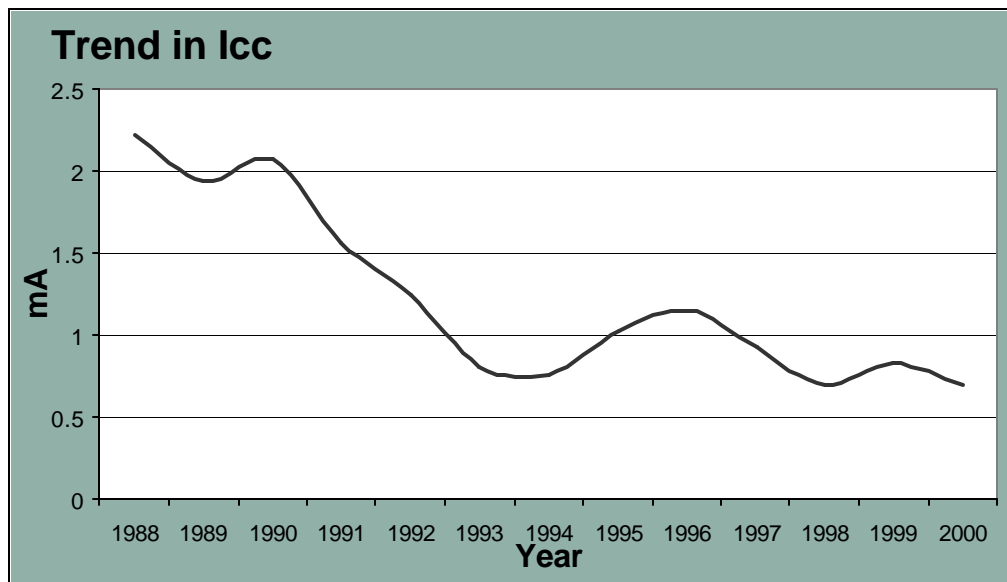


FIGURE 13

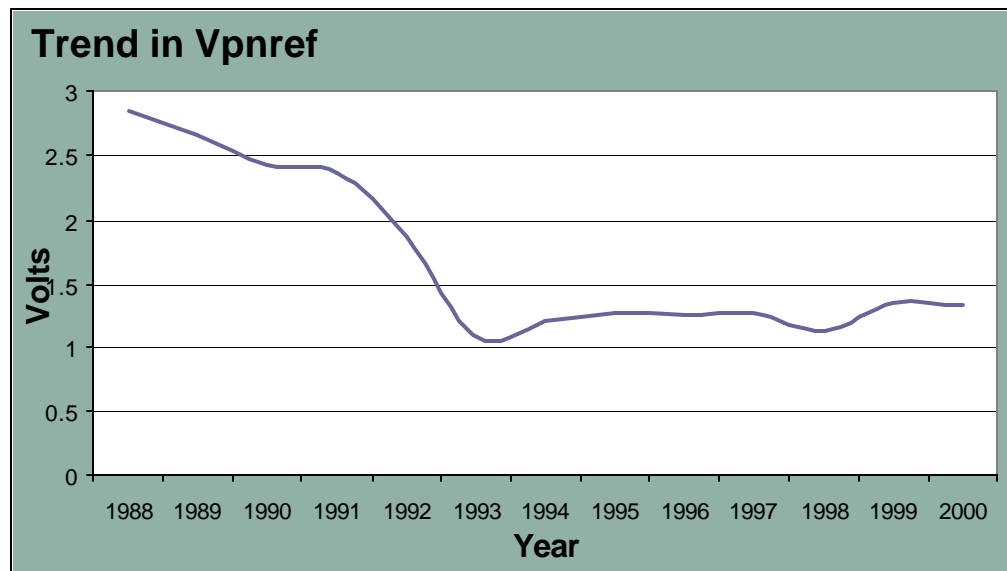


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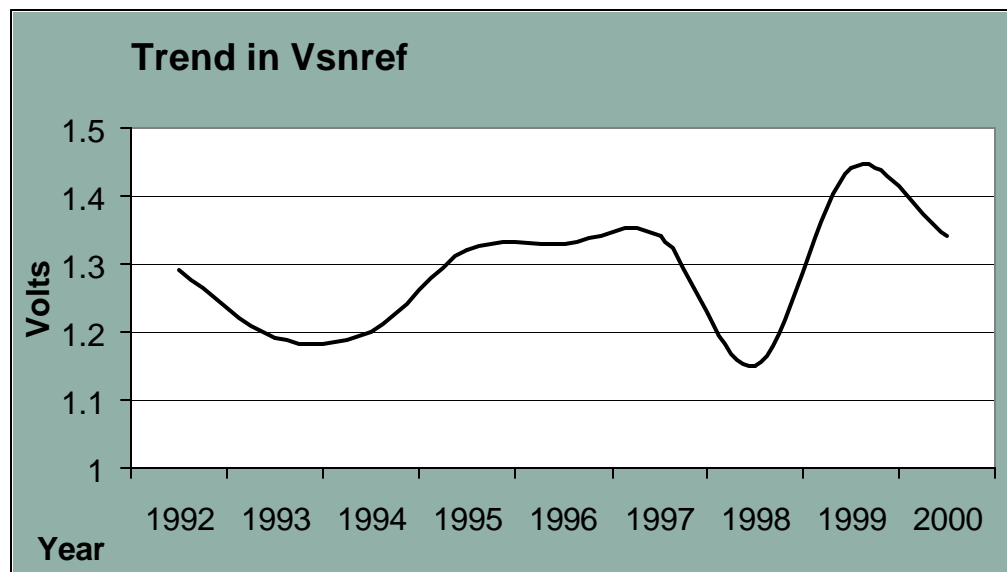


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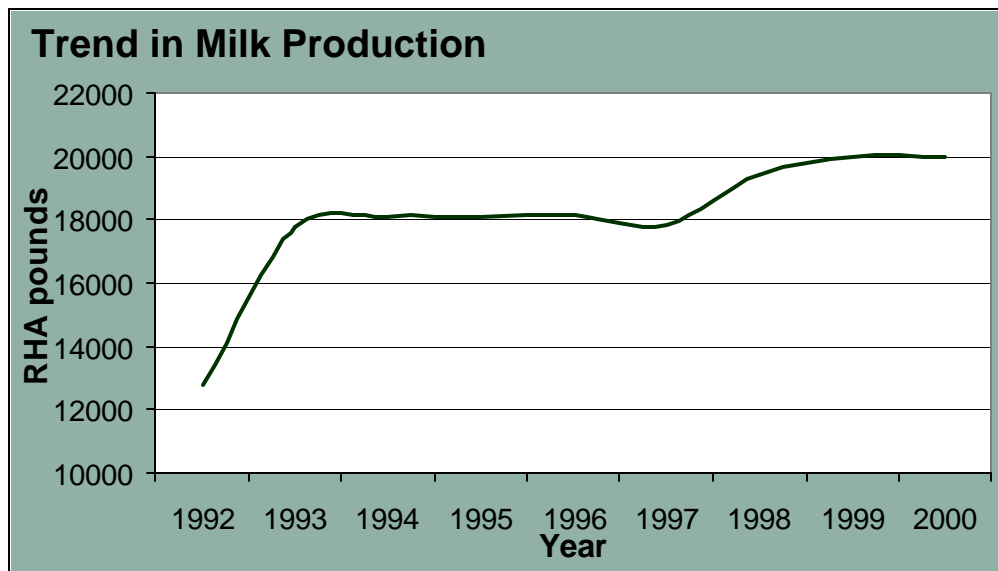


FIGURE 16

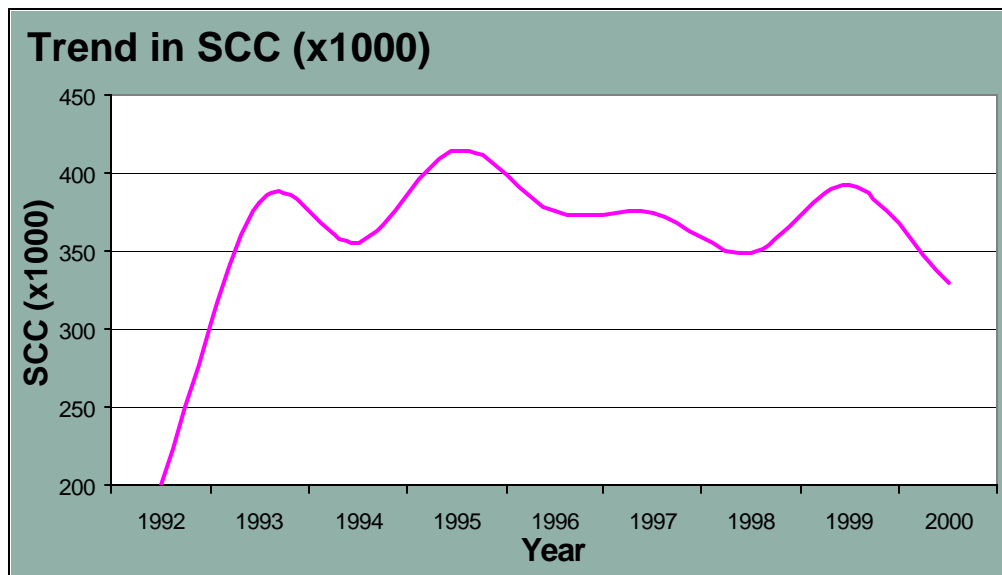


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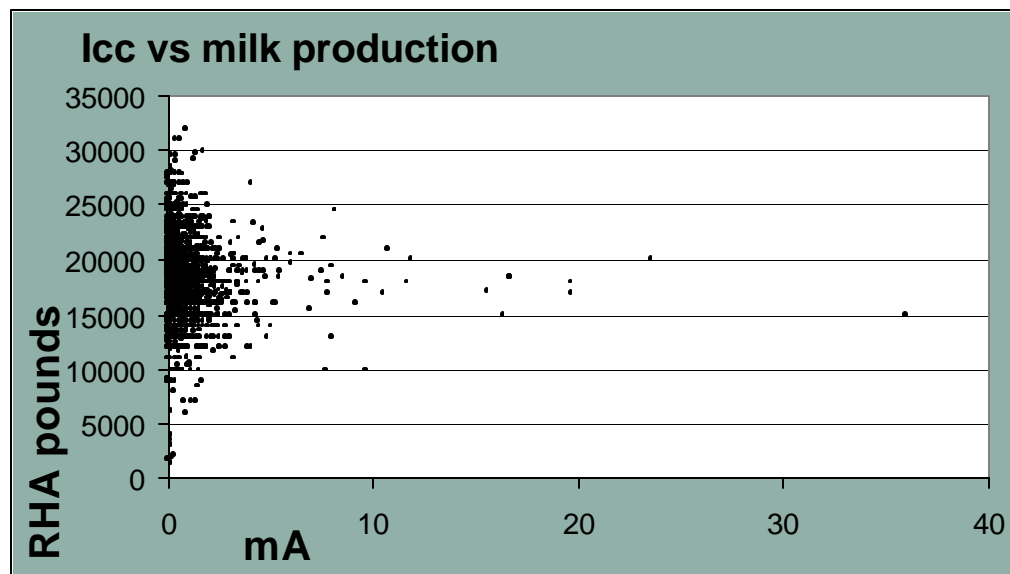


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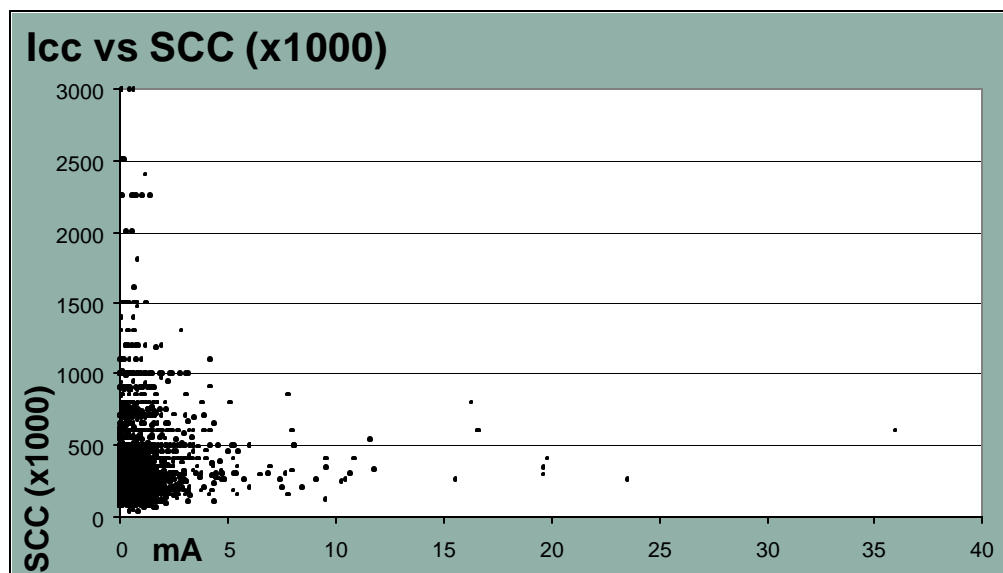


FIGURE 19

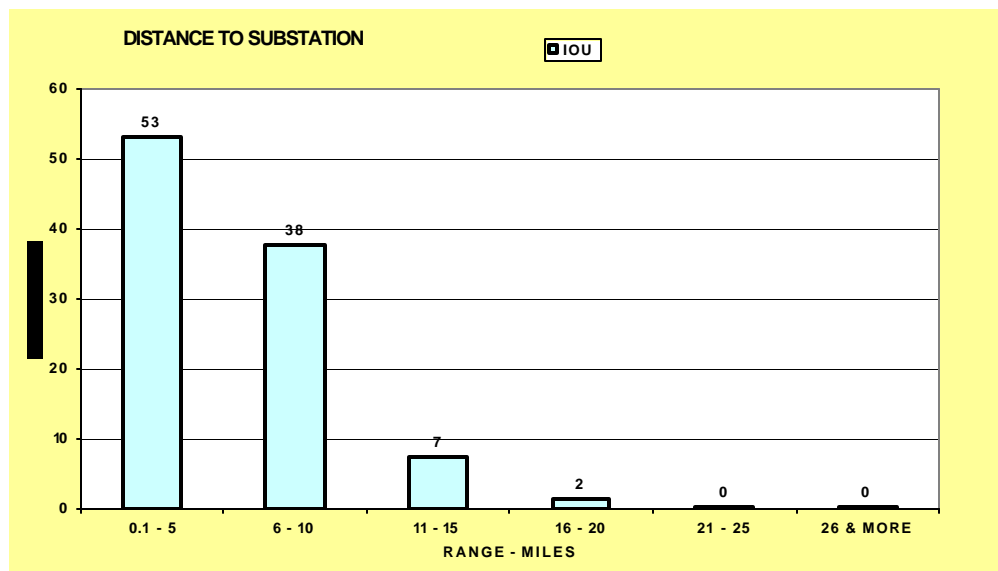


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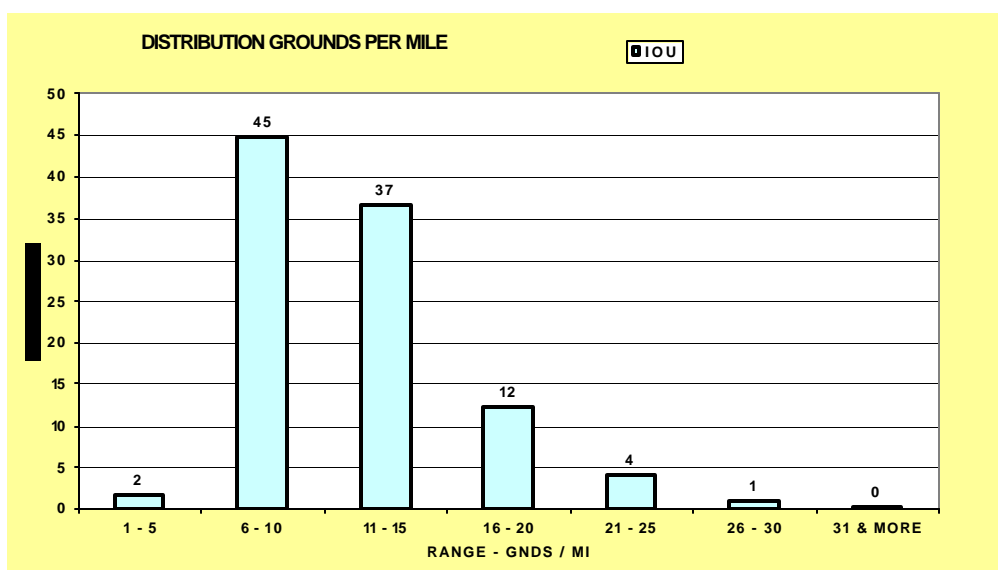


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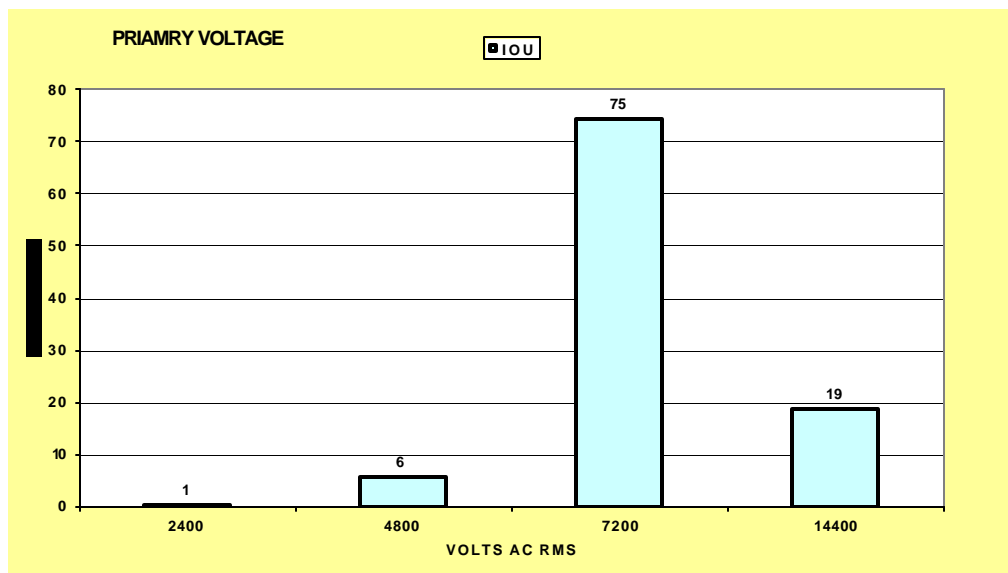


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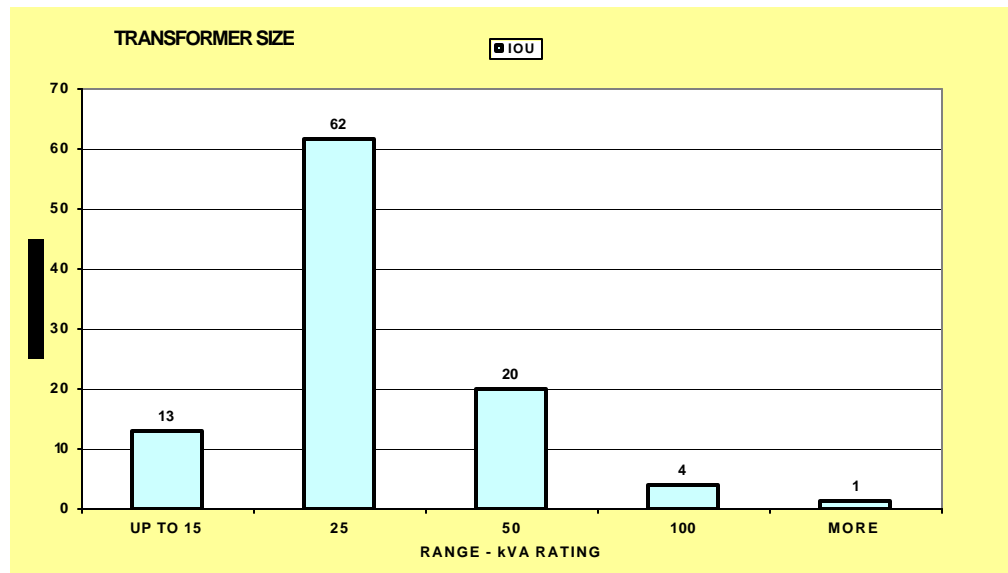


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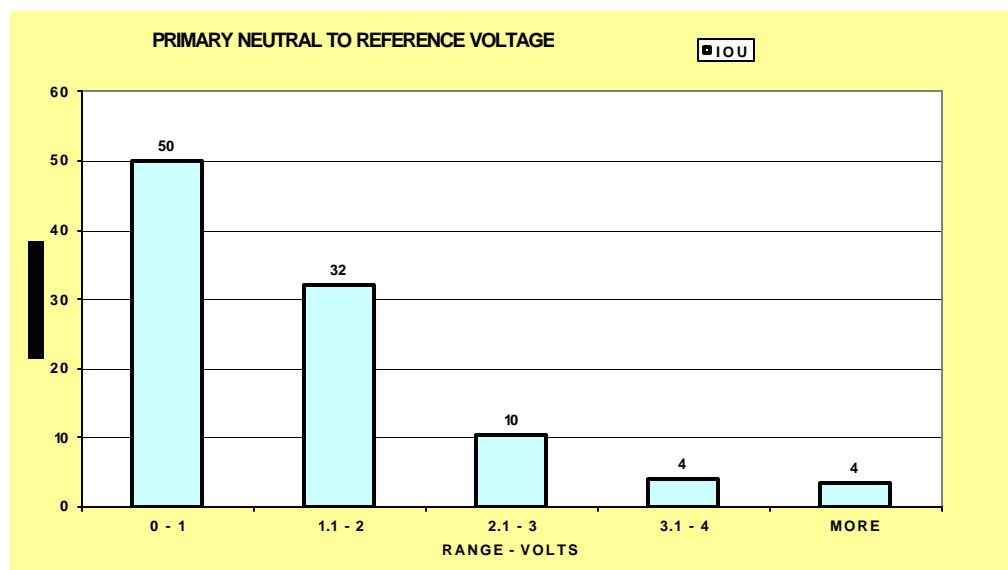


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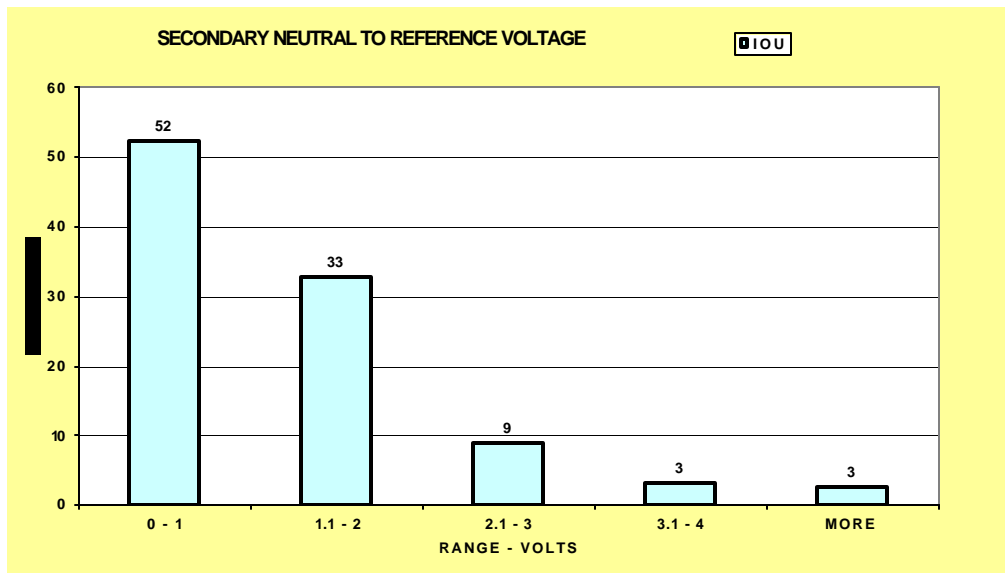


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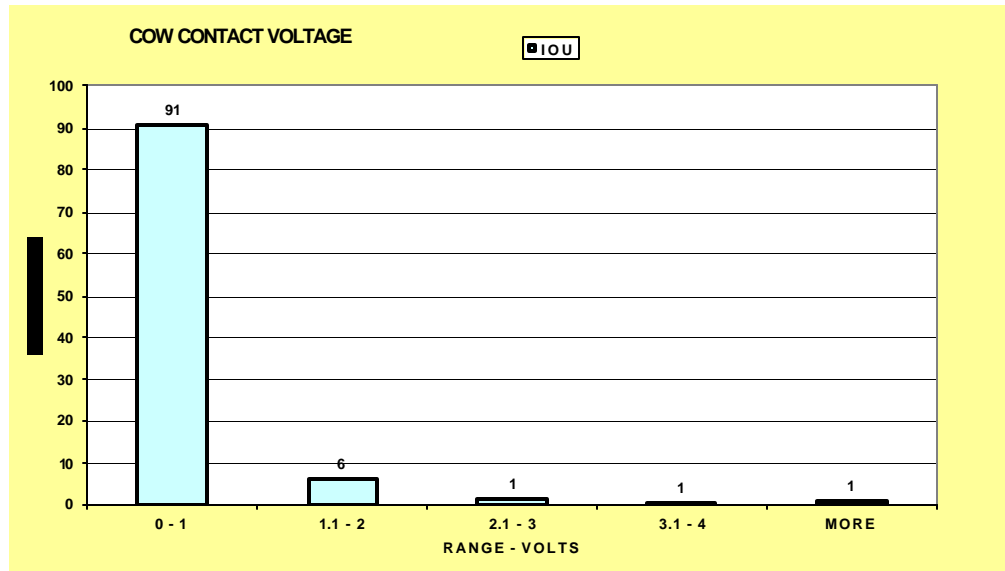


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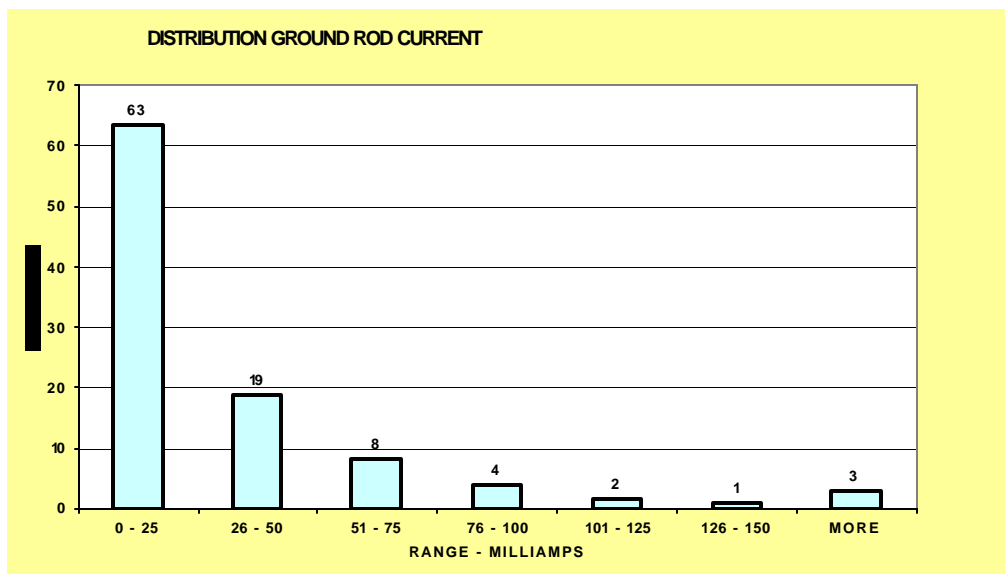


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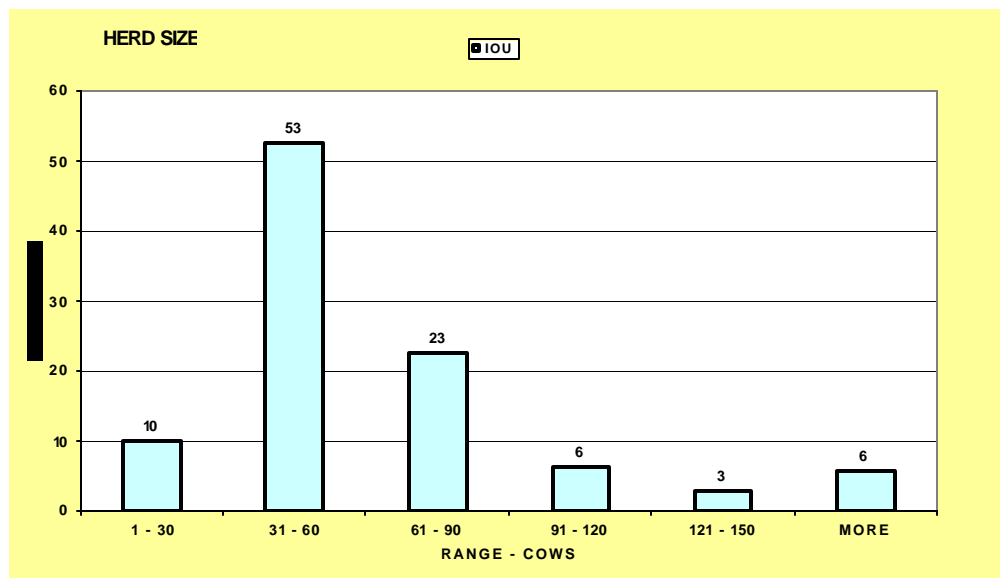


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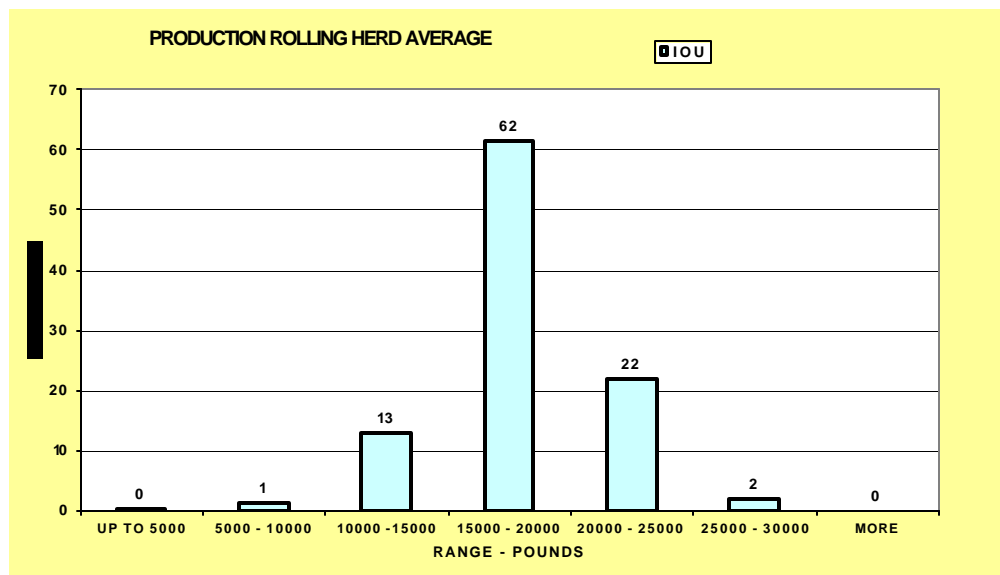


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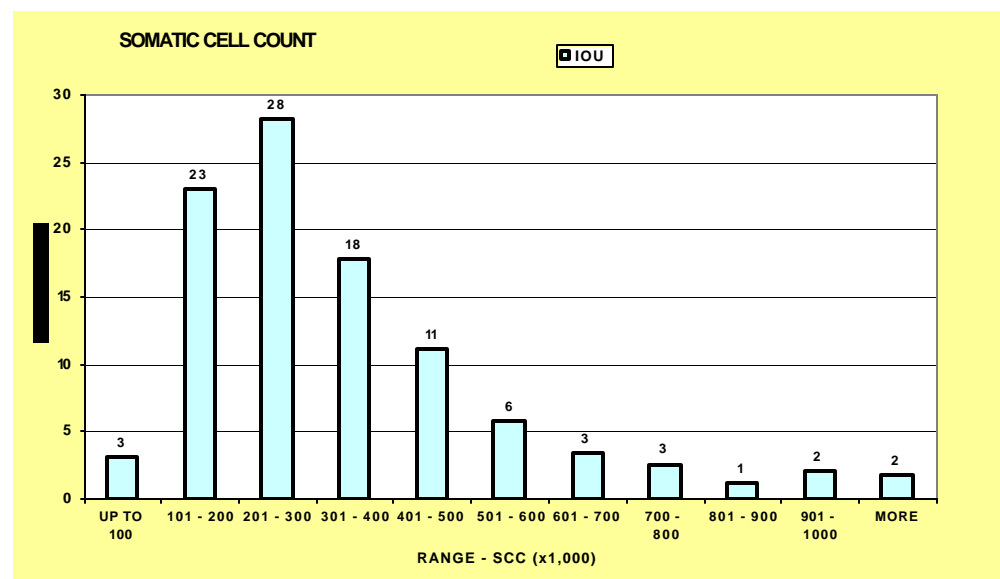


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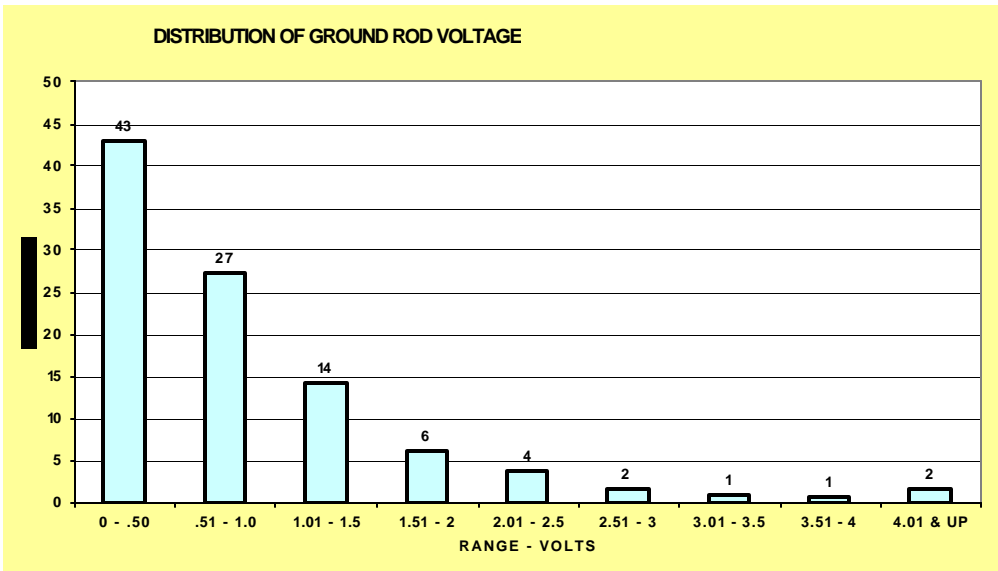


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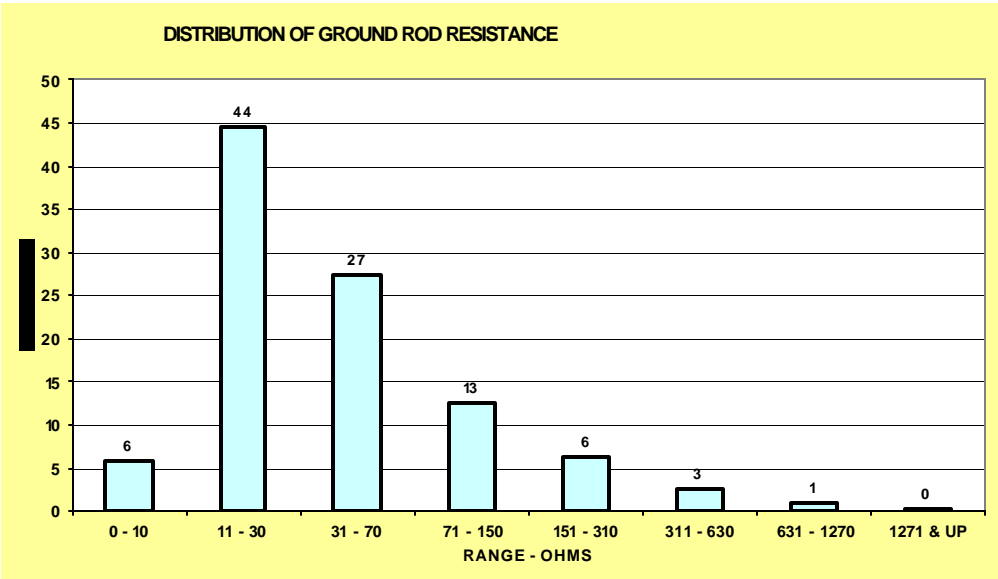


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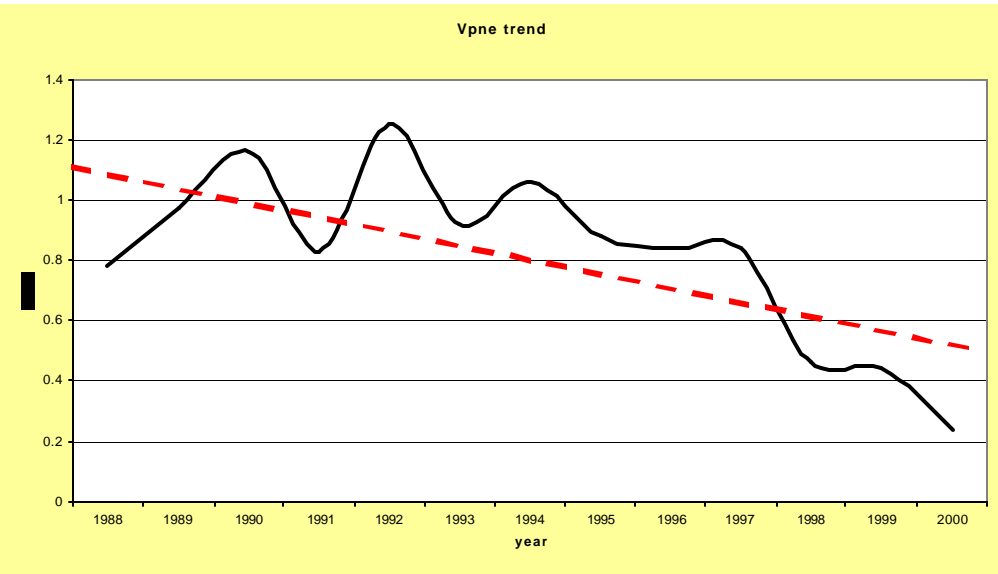


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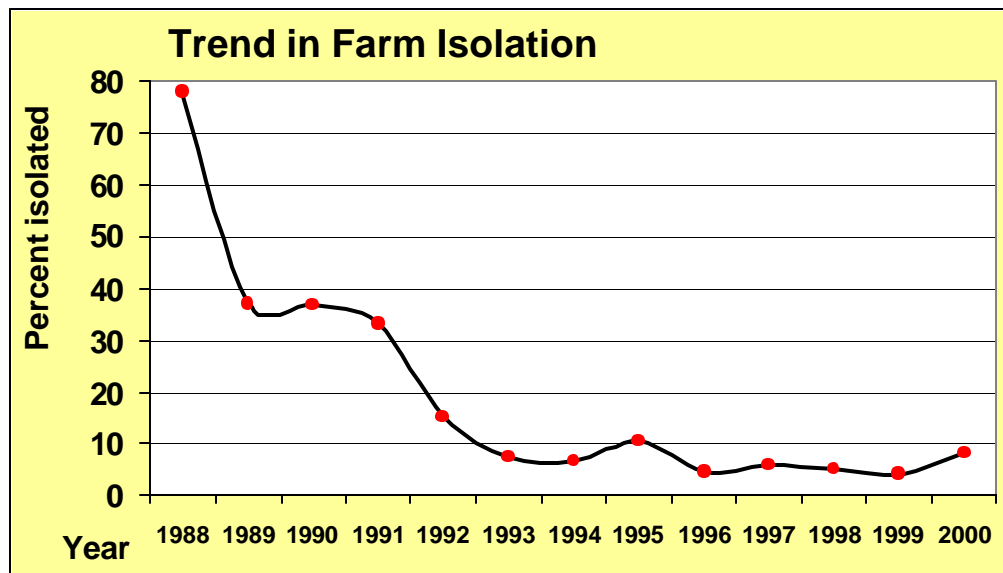


FIGURE 34